Telegrab

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THIS IS AN ADVANCED TO INTERMEDIATE PROJECT AND SHOULD NOT BE ATTEMPTED BY A NOVICE WITHOUT SOME EXPERIENCED HELP.

IT IS SUGGESTED THAT THE NOVICE OBTAIN OUR "GENERAL CONSTRUCTION TECHNIQUES" AVAILABLE FOR $5.00. ORDER #GCAT1.

ASSEMBLY OF THREE OR MORE OF THESE UNITS FOR SALE MAY REQUIRE FCC APPROVAL.

TELGRAB

Your Telgrab telephone security device allows you to use any telephone to monitor a target premise via a sensitive microphone amplifier or access an existing "on going" telephone conversation. An emergency CALL BREAKIN function is also included. Operation involves dialing the target phone and simply entering a special code via the telephone key pad to select the proper monitoring function.

BEFORE PROCEEDING PLEASE BE AWARE OF THE FOLLOWING: ASSEMBLY OF THESE DEVICES FOR RESALE MAY REQUIRE FCC APPROVAL.

INTERCEPTION OF ORAL COMMUNICATION IS ILLEGAL IN MOST STATES AND CAN LEAD TO CRIMINAL PROSECUTION. THE TELGRAB1 IS INTENDED TO BE USED ON YOUR OWN HOME OR OFFICE PHONE. ALWAYS CHECK LOCAL LAWS WHEN IN DOUBT. CERTAIN STATES MAY REQUIRE A "TONE ALERT" WHEN CONNECTING TO THE PHONE LINES. CHECK WITH YOUR ATTORNEY GENERAL'S OFFICE.

The system was designed around ATT (EES) electronic switching system. Performance may vary slightly due to the many different telephone companies now in existence.

CAUTION - Failure to properly shut down the call can result in the "CALLED TO" "phone" being left in an off hook state. This usually will require physical access to the device for electrically resetting - obviously a great inconvenience as it is impossible to index any function when in this state by use of the "CALLED FROM" phone. CAUTION - Always "key in" the "TERMINATE FUNCTION" before hanging up. Note some telephone systems may cause this state to terminate automatically.

A dedicated line is suggested for full use of all functions as this approach eliminates any timing or access

problem resulting from varying performance of different phone systems. Proper choice of the INITIAL ACCESS TIME is very important if only a single line is attempted. This is emphasized in the plans as a "special note".

Assembly is easily housed in an enclosure of your choice. Any suitable metal or plastic box will usually suffice.

CIRCUIT DESCRIPTION-SIMPLIFIED SCHEMATIC (REF FIG 2)

Battery B1 supplies 6 volts to the circuit via the VCC line. The initial "POWERING UP" causes Timer I3 to momentary hold a "high" and reset counter I4 to a zero state.

When a call is placed to the "CALLED TO" phone line connected to P1, a negative pulse initiates Timer T1 turning on Q1 and relay K1, connecting transformer T1 into the telephone line. It is this interval while I1 is "on" that a tone signal is required from the # key from the "CALLED FROM" phone. This tone is decoded by I2. It is further processed and indexes the counter I5 to (1) state. This output now latches Q1 "on" and turns on amplifier I6 via the turn on of clamp transistor Q6. Room sounds picked up by microphone M1 are now amplified and fed back thru T2 to T1 into the phone lines allowing room listening of the premises. This is the "ROOM LISTEN" mode.

The system can now be changed to mode 2 by again pushing the # key and indexing to this second function that now allows "MONITORING AND BREAKING" into an on going telephone conversation via the "LISTEN TO PHONE" line connected to P2.

Counter I5 now holds on Q2 and turns on relay K2 connecting T3 into the P2 "LISTEN TO TELEPHONE" line. Diode D14 clips the inductive kick when K2 is turned off. Signals now on line P2 are connected into line P1 allowing BREAKIN or just LISTENING to the phone activity on the P2 line.

Complete DC isolation between the two telephone lines connected to P1 & P2 is accomplished by K2 and its isolated contacts.

The "TERMINATE FUNCTION" mode is accomplished by a third activation of the # key from the "CALLED FROM PHONE" indexing counter I4 and turning off Q1 and all other functions, restoring normal telephone use.

CONSTRUCTION STEPS

1. ( ) Layout and identify all parts and pieces, check with parts list. Note that some parts may sometimes vary in

value. This is acceptable as all components are 10 to 30% tolerance unless otherwise noted. Match letters of schematic and scotch tape together.

Beginning hobbiest may wish to obtain our "GCAT1 GENERAL CONSTRUCTION TECHNIQUE described on the cover sheet before proceeding.

2. ( ) Layout PB1 perfboard as shown FIG 3. It is suggested to note the actual hole locations along the borders and use those shown for components insertions. The size of the board is not critical as it must only fit into the enclosure of your choice.

NOTE: You may wish to fabricate a printed circuit board for this circuit. A board will soon be available from the factory. It is suggested to contact them for availability.

3. ( ) Assemble board as shown FIG 3, Position sockets for intergrated circuits as shown. Secure using a dab of crazy glue etc. Start to insert components into the board holes as shown. Note to start and proceed from right to left attempting to obtain the layout as shown. Note polarity and orientation of components as shown.

Note: Certain leads of the actual components will be used for connection points and "circuit runs". Do not cut or trim them at this time. It is best to temporarily fold the leads over to secure the individual parts from falling out of the board holes for now. Proceed doing sections at a time using this procedure.

Note: T1, 2, 3 are 600:1200 insolation/impedance matching transformers. You can identify the winding using an ohm meter.

The 600 ohm winding reads a DC resistance of approx. 50 ohm. The 1200 ohm winding reads a DC resistance of approx. 100 ohm (marked "P") or colored.

Note that impedance is a complex number consisting of DC resistance and AC reactance in conjugate. Most transformers impedances are specified at 1000 HZ.

The pins of these transformers must not be stressed or the fine wires will break making the part unusable. A printed circuit board usually prevents this problem.

4. ( ) Connect up P1 and P2 modular, cables note colored leads red to common ground, green to input - This wiring should match to most telephone line jacks, note red on telephone is ground or negative. **NEVER** earth ground red or green lead as hum level will disable use.

Note: We have found that several sources of these modular plug assemblies do not make a positive contact with certain modular jacks. It is suggested to verify definite contact by wiggling the connection and verify a steady voltage reading before using.

TEST STEPS REF SCHEMATIC

1. Verify accuracy of all wiring, correct placement of components, solder bridges, solder shorts, cold solder and unsoldered joints, polarity of components etc.

Do not insert IC in sockets at this time. Wiring errors can damage these components and make trouble shooting very difficult.

2. Measure continuity between the following points and ground.

PIN 1 OF I1
PIN 8 OF I2
PIN 7 OF I4
PIN 1 OF I3
PIN 8, 13 OF I5
EMITTER Q1, Q2, Q6
PIN 4 OF I6
T1 SEC

3. Connect in a 6 volt source to battery clip - Note polarity. Current draw should be .1 to .2 milliamps. Measure 6 volts between the following points and ground.

A. PIN 4 & 8 OF I1
B. PIN 3,4,6 OF I2
C. PIN 4,8 OF I3
D. PIN 14 OF I4
E. PIN 16 OF I5
F. COLLECTOR OF Q1,Q2
G. PIN 7 OF I6
H. COLLECTOR OF Q5

4. Connect P1 into a standard phone jack that is also connected to a "test" dial tone phone. It may be necessary to obtain a 1 to 2 phone splitter for paralleling connection.

5. Insert timer I1 into socket-or solder onto PC board. Connect meter to collector tab of Q1 and set on 10 volt range-measure 6 volts.

6. Short out P1 and note meter in Step 5 momentarily dropping to near zero. You will note resistor R32 is 390K. It may be necessary to put in a lower value for reliable triggering of I1. If value is to low it may "chatter" making the system useless. Try a compromise as excessive chatter can destroy K1 and R2 contacts. (You may also lift test phone jack from hook).

7. Turn off power via S1 and insert decoder I2 into socket. *Set R29 to midrange. Turn on S1.

8. Measure a high level on pin 13 & 14 each time # pad is pressed on connected in "test" phone.

THIS VERIFY OPERATION OF DECODER FUNCTION

9. Turn off power via S1 and insert I4. Turn on power and note a low on pin 3 each time #pad is pressed. Measure inverted signal at pin 4 for this function.

10. Turn off power via S1 and insert I3. Measure a momentary 5 volt level on pin 3 each time power is turned on.

11. Turn off power via S1 and insert I5. Turn on power and note pins 2,4 are low, pine 3 and 12 are high.

12. Press # pad and note pins 2 and 4 of I5 each repeating every 3rd press.

This verifys operation of the logic, reset digital processing and function counter.

13. Turn off power and insert I6, adjust R17 to midscale. Turn on power. Press #pad and note microphone circuit coming to life as heard over ear piece on test telephone. This verifys ROOM LISTEN MODE.

14. Connect meter to called tab of Q4 and note a reading of 6 volts. Press #pad and note voltage dropping to zero. This energizes K2 for the LISTEN TO PHONE FUNCTION.

15. Press #pad and note a high reading on pin 3 of I5. This is the TERMINATE FUNCTION or RESET MODE. Pins 2 and 4 of I5 should be a "definite low".

ALL CONTROL FUNCTIONS ARE VERIFIED.

The following steps require two individual telephone lines.

LINE A WILL BE THE CALLED FROM PHONE.
LINE B WILL BE THE CALLED TO PHONE.

measure 50 volts DC. Note red lead is usually minus on telephone line.

17. Turn on S1 and note no change in 50 volt reading. Sometimes there may be a momentary drop.

18. Lift off CALLED FROM PHONE and dial the number of the CALLED TO PHONE. Important - You must be quick to access the line with the #pad. Several attempts to gain familiarity is suggested before actually using.

19. You will note reasonable sensitivity and clarity of the existing sounds in the room. Turn on a radio for convenience.

20. Push #pad once and pause (this is the LISTEN TO PHONE MODE but obviously is not connected in for this test step as it would require a third line). Push #pad again and wait for return of dial tone in CALL FROM PHONE. This is the TERMINATE FUNCTION.

The next step requires a third or remote CALLED FROM PHONE line.

21. Plug in P2 to the second phone line on premise. This is the one previously used as the CALLED FROM PHONE - It now becomes the LISTEN TO PHONE.

22. Turn on power and verify full 50 volts DC on both phone lines. (Note any accidental incoming calls made at this time to the CALLED TO PHONE can screw up this test). A friend is suggested to monitor the DC volts on the lines.

23. Call the CALL TO PHONE from the remote CALLED FROM PHONE and access the LISTEN TO PHONE MODE with the second pressing of the #pad (refer to Step 18 & 20). This will be noted by a dial tone indicating accession of this line and obviously any on going conversation. Further testing will require an actual call to be "in process" on the LISTEN TO PHONE and may require a 4th line. It is suggested to use a friend for this test to verify the listening clarity and BREAKIN IN FUNCTION.

SPECIAL NOTE: The audio level between certain telephone connections may be weak in the LISTEN TO PHONE MODE. and require careful listening. Also the BREAKIN function may require a yell or loud talking to be heard.

SPECIAL NOTE (TELEPHONE COMPATIBILITY) - Certain telephone used to call from appear to have different levels of encoding signal level output. This may cause a reliability problem in 100% accessing of the system at all times. Compensation can sometimes be made by proper setting of R29.

SPECIAL NOTE (DEDICATED LINE) - Should be considered for a permanent installation especially when using other optional functions. This approach eliminates ring signal "sneak thru" and the critical timing of I1 for allowing access control yet still enabling incoming calls to get thru. Out going calls are not a problem.

SPECIAL NOTE (TIMER VALUES OF R5 AND C6) - The initial access time determined by the time constant of R5 and C6 may be set in most systems to allow a normal incoming telephone call to be made. If this time is to long an "off to on" hook condition is generated disabling the connection. If it is to short the encoding tones may not get thru. This is not a problem for outgoing calls and in most cases is acceptable using the longer time guaranteeing encoding control.

SPECIAL NOTE: This is a new circuit developed by our engineering department. It has been tested and verified on our telephone lines in southern N.H. - AT&T and performs as per the instructions. We cannot fully guarantee 100% performance on all telephone systems. Any modifications for improvement of the circuit for a particular telephone system are welcome.

SPECIAL NOTE: (OPTIONAL CONTROLLER) is soon to be available and will allow up to 8 programmable functions from turning on lights to controlling of pumps, coffee pots etc.

SPECIAL NOTE: (ROOM LISTEN AMPLIFIER) The gain of the audio circuit is not "super" sensitive but is adequate for hearing normal voice level conversations within the room it is installed in. Further sensitivity of the circuit could cause legal questions classifying it as a <u>bugging device</u>.

At this time our engineering department is implementing performance improvement revisions. Customers who have purchased kits will be kept informed of this changes. We also welcome suggestions from the field in circuit improvement.

We have provided the following brief component function section relating "to" and "in order" as listed on the parts list. This we feel will assist in any trouble shooting that may be required.

<u>COMPONENT FUNCTION REF PART LIST AND SCHEMATIC</u>

R1	DECOUPLING RESISTOR.
R2	THIS RESISTOR HOLDS THE TRIGGER INPUT OF TIMES I1 POSITIVE -DEACTIVATED.
R3	COUPLING RESISTOR FOR CALLED TO TELEPHONE LINE.
R4	PROVIDE BIAS FOR D1,2
R5	TIMING RESISTOR CHARGING C6. ESTABLISH TIME FOR CONTROL INITIATE LINE ACCESS - SEE NOTE
R6,7,8	CURRENT LIMIT RESISTORS TO BASE OF Q1 FROM CONTROL FUNCTIONS.
R9	BIAS RESISTOR FOR CRYSTAL - X1.
R10	TIMING RESISTOR FOR CHARGING C12. ESTABLISHES TIME FOR LOGIC RESET PULSE WHEN SYSTEM IS TURNED ON.
R11	BIAS RESISTOR FOR RESET OF FUNCTION COUNTER I5. CURRENT LIMIT RESISTOR FOR D13.
R12	THIS PART IS DELETED IN THIS REVISION.
R13	COUPLING RESISTOR TO "LISTEN TO" TELEPHONE LINE.
R14	LOAD RESISTOR FOR COLLECTOR OF Q5.
*R15	FEED BACK AND GAIN CONTROL RESISTOR FOR Q5.
R16	LIMIT RESISTOR.
R17	GAIN CONTROL FOR MODE 1 "ROOM LISTEN" FUNCTION.
R18	GAIN SET FOR AMPLIFIER I6..
R19,20	INPUT RESISTORS TO I6.
R21	LOAD RESISTOR FOR MICROPHONE M1 INTERNAL FET.
R22,23	VOLTAGE DIVIDER RESISTOR FOR I6 BIAS SET.
R24	BASE CURRENT LIMIT RESISTOR FOR AUDIO SECTION CLAMP TRANSISTOR Q6.
R25	BASE CURRENT LIMIT RESISTER FOR Q2.
R26	DECOUPLING RESISTOR FOR AUDIO AMPLIFIER SECTION.
R27,28	BIAS BASES OF Q1,2 TO GROUND WHEN IN OFF STATE MODE.
R29	DECODER SENS SET CONTROL POT.
R30	DISCHARGE RESISTOR FOR TURN ON CAPACITOR C2.
R31,33	LIMITS CONTACT CURRENT K1 AND K2 FROM MOMENTARY DISCHARGE OF C3, 15 RESPECTIVELY.
R32	RESISTOR FOR INITIAL TURN ON PULSE TO I1. SELECT FOR RELIABLE TRIGGERING YET LARGE ENOUGH TO PREVENT CHATTERING ERRONEOUS TURN ON.
C1	BYPASS AND DECOUPLING CAPACITOR.
C2	THIS CAPACITOR COUPLES A NEGATIVE PULSE TO I1 FOR TURN ON WHEN THE TELEPHONE LINE VOLTAGE DROPS FROM APPROX 50V TO 8V. THIS FUNCTION INITIATES THE SYSTEM.
C3	AC BYPASS FOR VOICE AND TONE FREQUENCIES.
C4	COUPLING CAPACITOR FOR INPUT TONE FROM CALLED TO TELEPHONE LINE TO DECODER SENS SET CONTROL POT.
C5	BYPASS TO STABILIZE MODULATION INPUT OF TIMER I1.
C6	TIMING CAPACITOR IN CONJUNCTION WITH R5 SETS THE ACCESS TIME TO KEY IN CONTROL TONES. THIS VALUE MAY BE ADJUSTED ON CERTAIN TELEPHONE SYSTEMS TO ALLOW NORMAL FUNCTIONS OF TELEPHONE OPERATION EVEN WHEN SYSTEM IS ACTIVATED-THIS MAY BE TRICKY!
C7	DECODER DC BLOCKING CAPACITOR.

C8	HIGH FREQ BY PASS CAPACITOR FOR I2.
C9	HIGH FREQ BY PASS OF VC LINE.
C10	HIGH FREQ BYPASS FOR NAND-GATE I4A AND INVERTER I4B.
C11	HIGH FREQ BYPASS FOR COUNTER I5.
C12	I3 TIMING CAPACITOR IN CONJUNCTION WITH R10 TO ESTABLISH RESET PULSE TIME WHEN SYSTEM IS FIRST INITIATED.
C13	BYPASS TO STABILIZE MODULATION INPUT OF TIMER I3.
C14	THIS PART IS DELETED..
C15	AC BYPASS FOR VOICES AND TONES TO THE "LISTEN TO" TELEPHONE LINE BEING ACCESSED.
C16	BYPASS GROUNDING RETURN CAPACITOR FOR AUDIO AND ENCODING TONES ON ISOLATED WINDING OF T1,2,3.
C17	OUTPUT AC COUPLING CAPACITOR FOR AUDIO SIGNAL FROM Q5.
C18	SIGNAL BYPASS FOR AUDIO FROM I6.
C19	AUDIO INPUT COUPLING CAPACITOR FOR SIGNAL FROM M1.
C20,21	STORAGE CAPACITORS FOR VOLTAGE DIVIDING OF R22 AND R23 NECESSARY FOR DC BALANCE BIASING OF I6.
C22	AUDIO BYPASS OF CLAMP TRANSISTOR Q6.
D1,2	RING VOLTAGE BLOCKING AND CLAMPING DIODES.
D3,4,5	ISOLATION DIODES FOR BASE OF Q1 CONTROL SIGNALS.
D6	SNUBBING DIODES FOR Ldi/dt OF TRANSFORMER T1 WHEN Q1 TURNS OFF.
D7	HOLDING DIODE FOR RESET PULSE OF I3.
D8	SIGNAL DIODE FOR ISOLATION OF RESET PULSE FROM I3.
D9	COUNTER RESET DIODE. TELLS COUNTER TO ONLY GIVE 0, 1 AND 2 STATE THEN RESET BACK TO 0 STATE.
D10	OPTIONAL FUNCTION INDICATING LED DIODE FOR NOTING "LISTEN TO PHONE" MODE WHEN ACTIVATED.
D11	OPTIONAL FUNCTION INDICATING LED DIODE FOR NOTING "ROOM LISTEN MODE" WHEN ACTIVATED.
D12	SNUBBING DIODE FOR Ld1/dt OF TRANSFORMER T3 WHEN Q4 TURNS OFF.
D13,14	SNUBBING DIODES FOR INDUCTIVE KICK OF RELAYS WHEN DENERGIZED.
D15	BLOCKS NEGATIVE RING VOLTAGE TO T1.
Z1,Z2	15 VOLT CLAMPS FOR RING SIGNAL AND INDUCTANCE KICK ON T1 AND T3-IN CONJUNCTION WITH D6 AND D12.
Q1	TRANSISTOR CLAMPS ENERGIZES K1 TO CONNECT PHONE LINE THRU 600 OHM TRANSFORMER T1. Q1 IS CONTROLLED BY THE FUNCTION INPUTS.
Q3,4	THESE TRANSISTORS ARE DELETED.
Q2	SIMILAR TO Q1 BUT NOW ENERGIZES K2 TO CONNECT IN THE "LISTEN TO" TELEPHONE LINE TO T3. Q2 IS CONTROLLED BY THE FUNCTION INPUT.
Q5	OUTPUT AUDIO TRANSISTOR DRIVES T2 AND PROVIDES AMPLIFIED SIGNAL FROM MICROPHONE M1 FOR ROOM LISTEN MODE. GAIN OF THIS STAGE IS CONTROLLED BY R17.
Q6	TURNS ON THE ROOM LISTEN MODE AUDIO AMPLIFIER

SECTION BY CLAMPING THE COMMON CIRCUIT RETURN TO SYSTEM GROUND.

I1 TIMER IS TURNED ON BY THE NEGATIVE PULSE LEVEL THAT OCCURS WHEN CALLED TO TELEPHONE LINE VOLTAGE DROPS. THIS IS USUALLY HAPPENS THE MOMENT THE LAST DIGIT OF THE TELEPHONE NUMBER IS KEYED IN FROM THE CALLED FROM PHONE. THE TIMER IS ONLY ON FOR A SHORT DURATION AND WILL RESET TO NORMAL PHONE OPERATION IF NO TONE SIGNAL IS KEYED IN. THIS CONTROL SIGNAL IS THE # PAD AND IS SIMULTANEOUSLY KEYED IN WITH THE LAST DIGIT TO ACCESS THE ROOM LISTEN MODE.

I2 THIS IS A CRYSTAL CONTROLLED DECODER DESIGNED FOR TELEPHONE INTERFACING. A SEPARATE SPEC SHEET IS ENCLOSED IN THESE INSTRUCTIONS.

I3 TIMER PROVIDES AN INITIAL POSITIVE RESET PULSE EVERY TIME THE SYSTEM IS TURNED ON BY SWITCH S1. THIS GUARANTEES THAT I5 IS AT THE "O" OR TERMINATE MODE.

I4A,B C MOS (NAND) CIRCUIT ENCODES THE DUAL OUTPUT LEVELS OF I2 AND PROVIDES A (POS LEVEL) AT PIN 3. THIS LEVEL IS INVERTED BY I4B TO A NEG LEVEL FOR TRIGGERING COUNTER I5.

I5 COUNTER INDEXES AS DECODER I2 RECEIVES PULSE TONES FROM THE #KEY ON THE CALL FROM TELEPHONE. THIS COUNTER ONLY COUNTS TO 2 AND RESETS. COUNT 0 IS THE TERMINATE OR (RESET), COUNT 1 IS FOR (ROOM LISTEN MODE) COUNT 2 IS FOR THE MONITORING A PHONE/CALL BREAKIN MODE. A SEPARATE SPEC SHEET IS ENCLOSED FOR THIS CIRCUIT

I6 CONVENTIONAL AUDIO PREAMPLIFIER FOR THE (ROOM LISTEN MODE). INPUTS ARE SET AT 1/2 VC FOR BALANCED OPERATION.

T1 TRANSFORMERS PROVIDES IMPEDANCE MATCHING AND ISOLATION OF THE TELEPHONE LINE TO THE SYSTEM. IT IS CONNECTED ACROSS THE LINE THRU R3 AND C3 WHEN K1 IS TURNED ON. AUDIO SIGNALS FROM THE ROOM LISTEN AMPLIFIER MODE AND THE LISTEN TO PHONE LINE ARE FED THRU TRANSFORMER T1.

T2 AUDIO IMPEDANCE AND ISOLATION TRANSFORMER FOR ROOM LISTEN MODE. FEEDS AUDIO OUTPUT OF AMPLIFIER BACK INTO TELEPHONE LINE.

T3 MATCHES AND ISOLATES LISTEN TO PHONE FROM TELEPHONE LINE TO FEEDBACK INTO T1. NOTE T1 AND T3 ARE BILATERAL PROVIDING A SIGNAL CONNECTION BOTH WAYS BETWEEN THE TWO LINES IN THIS MODE.

S1 SIMPLE SWITCH FOR ACTIVATING THE SYSTEM.

M1 CAPACITOR MICROPHONE WITH BUILT-IN FET FOR ROOM LISTEN MODE - SEE SPECIAL NOTE.

K1,2 ISOLATION RELAYS CONNECT IN TELEPHONE LINES WHEN TURNED ON BY CLAMP TRANSISTORS Q1 AND Q2 RESPECTIVELY.

PARTS LISTS

RESISTORS

R1, 26	2	10 OHM 1/4 WATT CARBON OR FILM RESISTORS
R2,4,19,20,21	5	10K 1/4 WATT CARBON OR FILM RESISTORS
R3,13	3	100 OHM 1/4 WATT CARBON OR FILM
R12		
R5,27,28	3	100K 1/4 WATT CARBON OR FILM RESISTORS
R6,7,8,11,14		
16,22,23,24,		
25	10	1 K 1/4 WATT CARBON OR FILM RESISTORS
R9,10,18	3	1M 1/4 WATT CARBON OR FILM RESISTORS
R15	1	15K 1/4 WATT CARBON OR FILM RESISTORS (NOTE FIG 1A)
R17,29	2	10K TRIMPOT (SEE FIG SCHEMATIC)
R30	1	10 MEG 1/4 WATT RESISTOR
R31,33	2	39 OHM 1/4 WATT RESISTOR
R32	1	390K 1/4 SEE NOTE FIG 1A FOR USE OF OTHER VALUES

CAPACITORS

C1,21,20	3	100mfd @ 25V VERTICAL ELECTR CAPACITOR
C2	1	.47 mfd 100V MYLAR OR PLASTIC CAPACITOR (SEE FIG SCHEMATIC)
C3,15,16	3	4.7mfd @ 100V NON POLARIZED ELECT CAP.
C4	1	.47mfd 50 VOLT PLASTIC CAP
C5,13	2	.01mfd DISC CAPACITOR
C14		NOT USED - DELETED
C6,22	2	10mfd @ 25V VERT ELECTR CAPACITOR
C7,8,9,10,11	5	.1 mfd @ 25V DISC CAPACITOR
C12	1	1mfd @ 25V VERT ELECT CAPACITOR
C17,18,19	3	2.2mfd @ 25V N.P. VERT ELECT CAPACITOR

SEMI CONDUCTORS

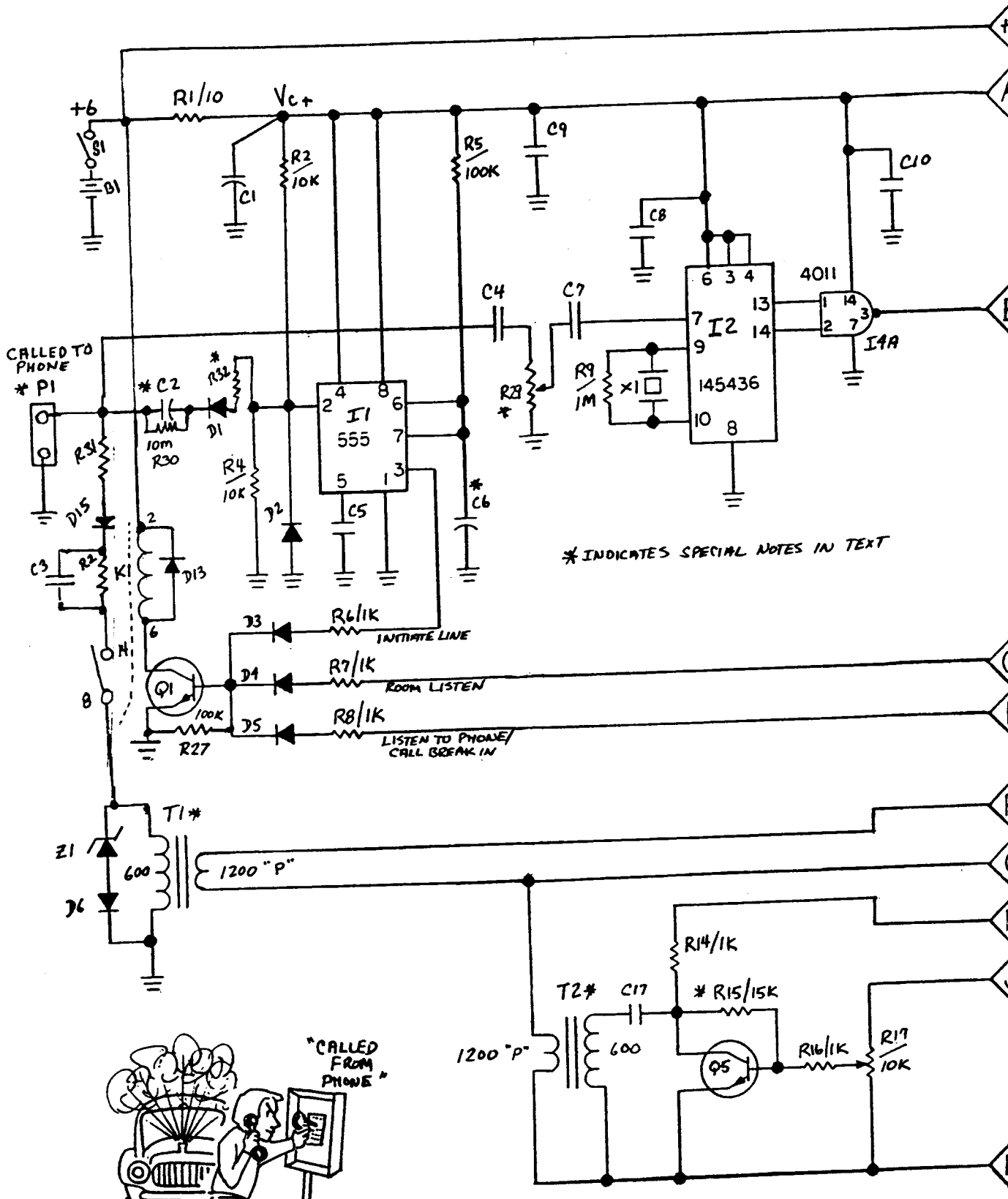
D1,26,12,13		
14,15	7	IN4007 RECTIFIER DIODE OR HIGHER SPEED FR103
D3,4,5,7,8,9	6	IN914 SIGNAL DIODES
D10,11	2	LIGHT EMITTING DIODES FOR CIRCUIT (SEE NOTES) FUNCTIONS (MAY BE OMITTED)
Z1,2	2	IN5245 16V ZENERS
I1,3	2	555 DIP TIMER
I2/X1	1	MC145436 BCP DECODER & CRYSTAL
I4	1	C-MOS 4011 NAND GATE
I5	1	4017 DIP DECADE COUNTER
I6	1	741 DIP OP AMP

Q1,2	2	D40D5 NPN POWER TAB TRANSISTOR
Q3,4		THESE PARTS DELETED
Q5,6	2	PN2222 GP SILICON NPN TRANSISTOR

MISCELLANEOUS

T1,2,3	3	ISOLATION/AUDIO INTERSTAGE TRANSFORMERS (SEE NOTE) 600 OHM TO 1200 OHM
K1,2	2	DIP RELAY 5 VOLT COILS SPST
S1	1	SLIDER SWITCH SPST
M1	1	CONDENSER MIKE
P1,2	2	RJ11 TELEPHONE CABLES WITH MODULAR PLUGS (SEE NOTE)
CL1	1	BATTERY CLIP
PB1	1	6" X 4 1/4" OF .1 X .1 PERFBOARD
WR1	36"	#22 BUSS WIRE
SO1	3	8 PIN IC SOCKETS FOR I1,3,6
SO2	2	14 PIN IC SOCKETS FOR I2,4
SO3	1	16 PIN IC SOCKETS FOR I5
TYE1,2	2	SMALL TYE WRAPS FOR STRAIN RELIEVING OF CABLES P1,2
BH1	1	4AA CELLHOLDER
BA1,2,3,4	4	AA 1.5V ALKALINE CELLS (NO INCL IN KIT)

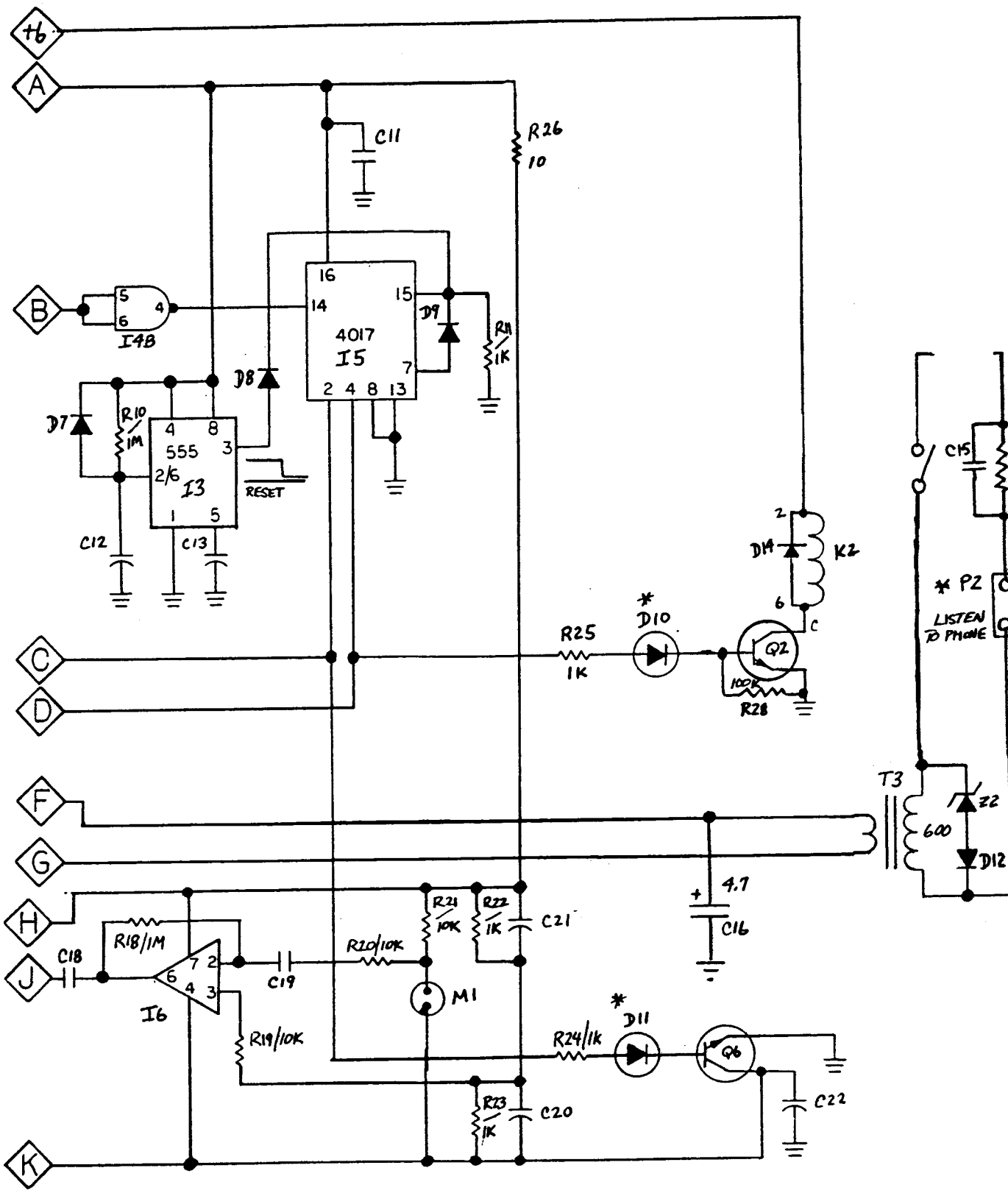
FIG 1A SCHEMATIC PART A



NOTE - R32 IS SELECTED TO PROVIDE RELIABLE TRIGGERING OF I1 YET STILL PREVENTING ERRONEOUS TRIGGERING OR CHATTER OF K1

NOTE - R15 IS SELECTED TO PROVIDE A DC QUIESCENT VALUE OF 2 TO 4 VOLTS AT THE COLLECTOR OF Q5.

FIG 1B SCHEMATIC PART B



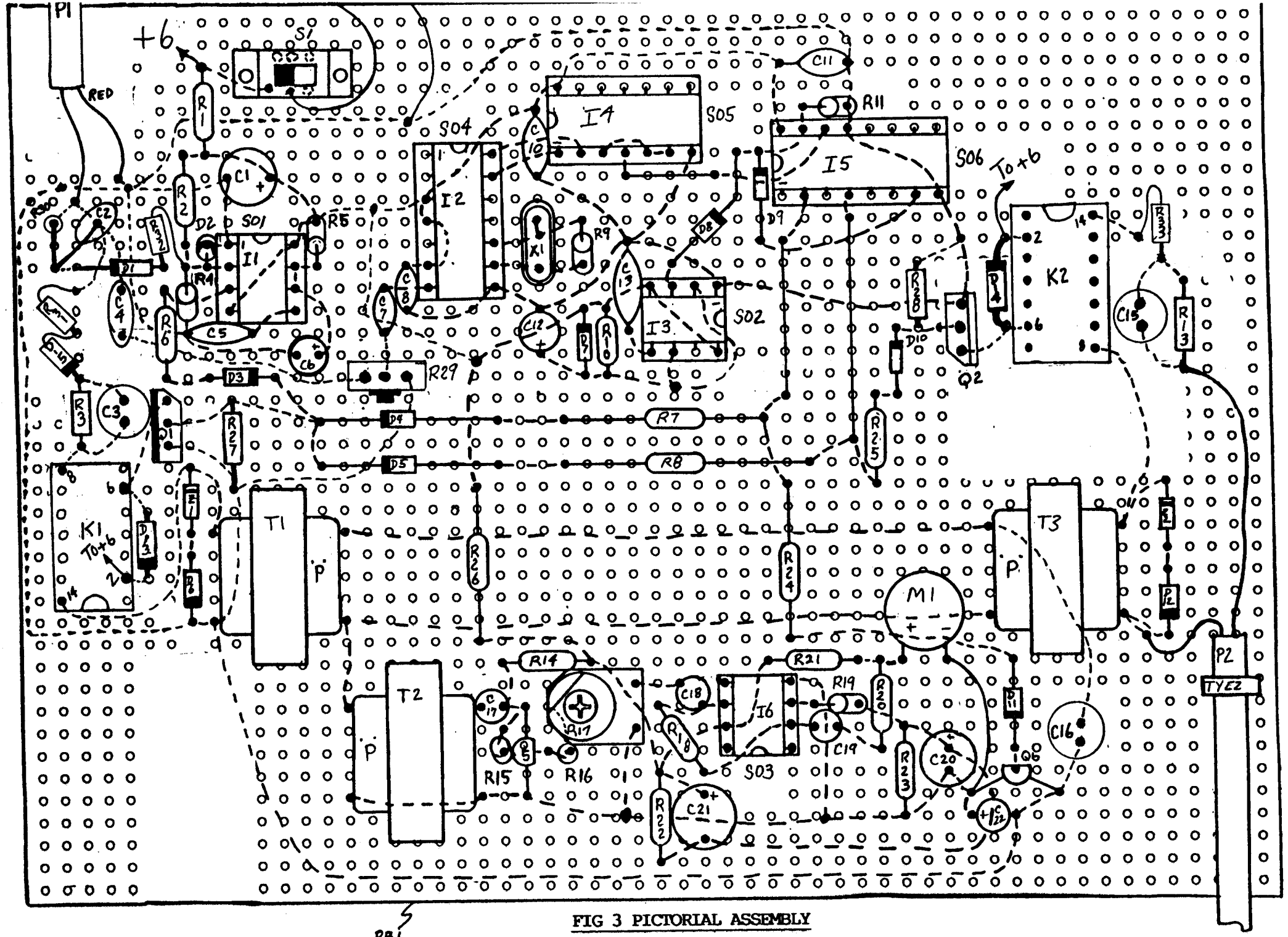
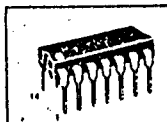


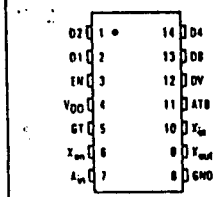
FIG 3 PICTORIAL ASSEMBLY

MC145436



P SUFFIX
PLASTIC
CASE 646

PIN ASSIGNMENT

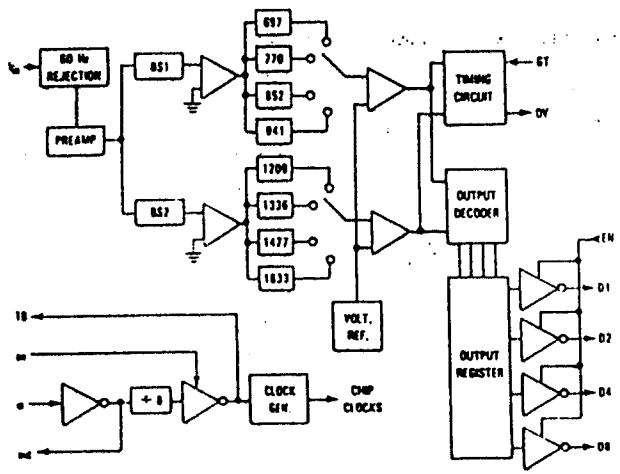


Advance Information

Dual Tone Multiple Frequency Receiver

The MC145436 is a silicon-gate CMOS LSI device containing the filter and decoder for detection of a pair of tones conforming to the DTMF standard with outputs in hexadecimal. Switched capacitor filter technology is used together with digital circuitry for the timing control and output circuits. The MC145436 provides excellent power-line noise and dial tone rejection, and is suitable for applications in central office equipment, PABX, key-phone systems, remote control equipment, and consumer telephony products.

- Single +5 V Power Supply
- Detects All 16 Standard Digits
- Uses Inexpensive 3.579545 MHz Colorburst Crystal
- Provides Guard Time Controls to Improve Speech Immunity
- Output in 4-Bit Hexadecimal Code
- Built-in 60 Hz and Dial Tone Rejection
- Pin Compatible with SSI-204



This document contains information on a new product. Specifications and information herein are subject to change without notice.

ABSOLUTE MAXIMUM RATINGS

(Voltages Referenced to GND Unless Otherwise Noted)

Rating	Symbol	Value	Unit
DC Supply Voltage	V_{DD}	−0.5 to +8.0	V
Input Voltage, Any Pin Except A_{in}	V_{in}	−0.5 to V_{DD} + 0.5	V
Input Voltage, A_{in}	V_{in}	V_{DD} − 10 to V_{DD} + 0.5	V
DC Current Drain per Pin	I	± 10	mA
Operating Temperature Range	T_A	− 40 to + 85	°C
Storage Temperature Range	T_{stg}	− 65 to + 150	°C

This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields; however, it is advised that normal precautions be taken to avoid applications of any voltage higher than the maximum rated voltages to this high impedance circuit.

For proper operation it is recommended that V_{in} and V_{out} be constrained to the range $V_{SS} \le (V_{in}$ or $V_{out}) \le V_{DD}$. Reliability of operation is enhanced if unused inputs are tied to an appropriate logic voltage level (e.g., either V_{SS} or V_{DD}).

ELECTRICAL CHARACTERISTICS

(All Polarities Referenced to V_{DD} = 5.0 V ± 10%, T_A = − 40 to + 85°C Unless Otherwise Noted)

Parameter		Symbol	Min	Typ	Max	Unit
DC Supply Voltage		V_{DD}	4.5	5	5.5	V
Supply Current (f_{CLK} = 3.58 MHz)		I_{DD}	–	7	15	mA
Input Current	GT	I_{in}	–	–	200	μA
	EN, X_{in}, X_{en}		–	–	± 1	
Input Voltage Low	EN, GT, X_{en}	V_{IL}	–	–	1.5	V
Input Voltage High	EN, GT, X_{en}	V_{IH}	3.5	–	–	V
High Level Output Current (V_{OH} = V_{DD} − 0.5 V; Source)	Data, DV	I_{OH}	800	–	–	μA
Low Level Output Current (V_{OL} = 0.4 V; Sink)	Data, DV	I_{OL}	1.0	–	–	mA
Input Impedance	A_{in}	R_{in}	90	100	–	kΩ
Fanout	ATB	FO	–	–	10	
Input Capacitance	X_{en}, EN	C_{in}	–	6	–	pF

ANALOG CHARACTERISTICS (V_{DD} = 5.0 V ± 10%, T_A = − 40 to + 85°C)

Parameter	Min	Typ	Max	Unit
Signal Level for Detection (A_{in})	−32	–	−2	dBm
Twist = High Tone/Low Tone	−10	–	10	dB
Frequency Detect Bandwidth (Notes 1 and 2)	± (1.5 + 2 Hz)	± 2.5	± 3.5	% f_C
60 Hz Tolerance	–	–	0.8	Vrms
Dial Tone Tolerance (Note 3) (Dial Tone 330 + 440)	–	–	0	dB
Noise Tolerance (Notes 3 and 4)	–	–	−12	dB
Power Supply Noise (Wide Band)	–	–	10	mV p-p
Talk Off (Mitel Tape #CM7290)	–	2	–	Hits

NOTES:
1. f_C is center frequency of bandpass filters.
2. Maximum frequency detect bandwidth of the 1477 Hz filter is + 3.5% to − 4%.
3. Referenced to lower amplitude tone.
4. Bandwidth limited to 3.4 kHz Gaussian noise.

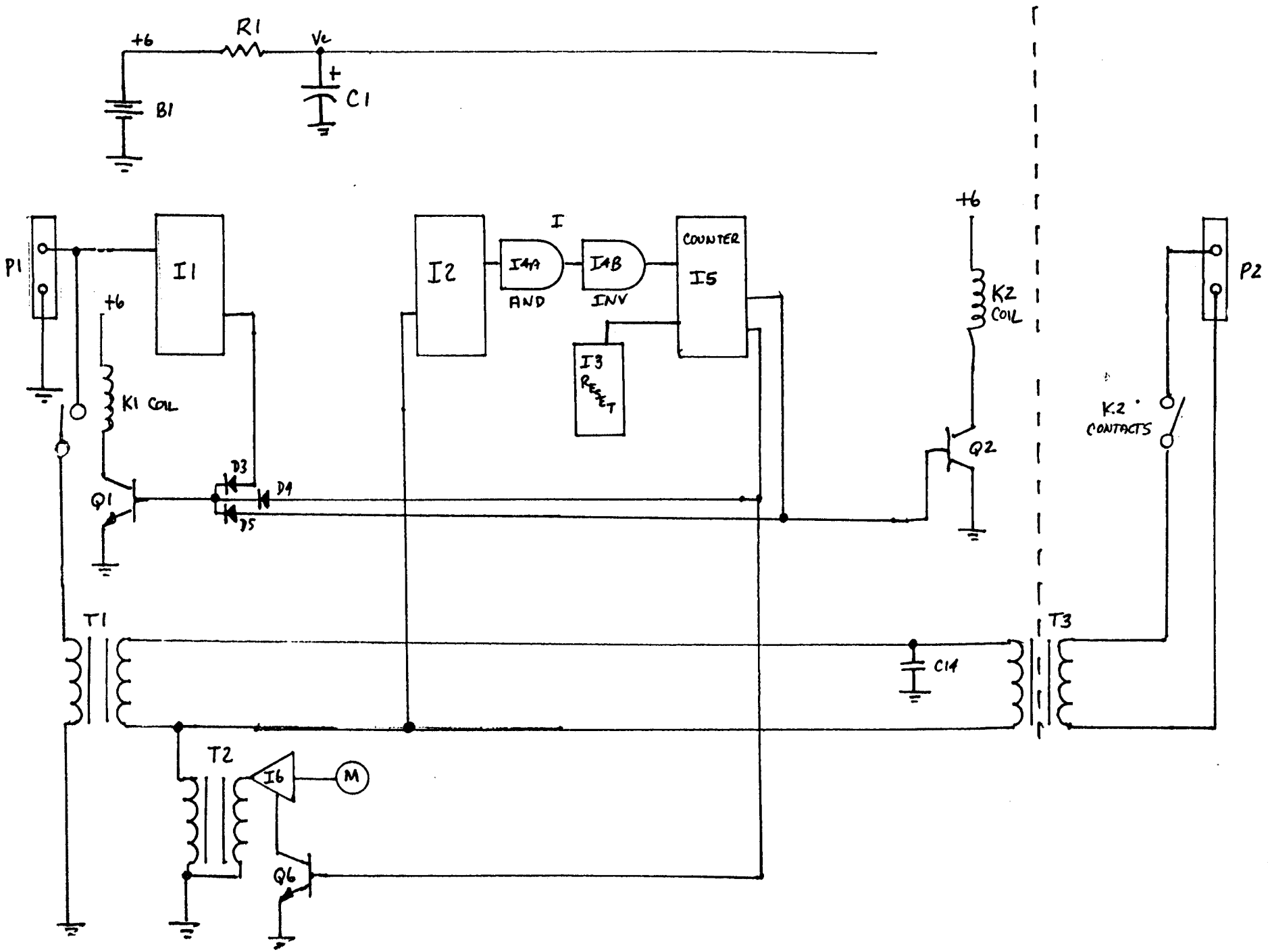



FIGURE 2 SIMPLIFIED FUNCTIONAL SCHEMATIC